КОНЪЮГИРОВАННАЯ ЛИНОЛЕВАЯ КИСЛОТА И ЕЁ ВЛИЯНИЕ НА УВЕЛИЧЕНИЕ СКОРОСТИ СНИЖЕНИЯ ВЕСА И УЛУЧШЕНИЕ АНТРОПОМЕТРИЧЕСКИХ ПОКАЗАТЕЛЕЙ У МОЛОДЫХ МУЖЧИН С ИЗБЫТОЧНОЙ МАССОЙ ТЕЛА НА ПРОТЯЖЕНИИ КОМПЛЕКСНОЙ ПРОГРАММЫ ПО СНИЖЕНИЮ ВЕСА

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ИСХОДНАЯ ИНФОРМАЦИЯ: С увеличением распространенности ожирения в Ираке возрастает приверженность к физической активности среди молодых людей. В то же время увеличение количества предлагаемых пищевых добавок способствует улучшению физической формы и позволяет избавиться от лишнего веса. Конъюгированная линолевая кислота (CLA – conjugated linoleic acid) часто используется для такой цели.

ЦЕЛЬ: Текущее исследование было предназначено в целях апробирования действия конъюгированной линолевой кислоты и ее способности действительно ускорять снижение веса в сочетании с диетой и умеренными физическими упражнениями, а также исследование их сочетанного эффекта в отношении атропометрических показателей при ожирении.

ОБЪЕКТЫ И МЕТОДЫ: 60 молодых мужчин добровольцев были включены в исследование, которое предполагало использование диеты с пониженным содержанием углеводов и жиров, а также комплекс высокоинтенсивных умеренных физических упражнений с временным интервалом (HIIT – high intensity interval exercise). 40 из них получали конъюгированную линолевую кислоту (1000 мг/день) в течение 8 недель, в то время как оставшиеся 20 участников составили контрольную группу. Индекс массы тела (body mass index – BMI), отношение окружности талии к окружности бедер (waist/hip ratio – WHR), сагиттальный абдоминальный диаметр (sagittal abdominal diameter – SAD), процент содержания жира в организме (body adiposity index – BAI) были зарегистрированы в начале, после 4 и 8 недель исследования.

РЕЗУЛЬТАТЫ: Группа участников, которая употребляла конъюгированную линолевую кислоту, показала существенно большее снижение всех показателей в конце исследования. В контрольной группе снижение показателей было значительным, но такие показатели как BMI и SAD оказались менее сниженными, чем в основной группе, однако WHR и BAI оставались аналогичными. Процент изменений отличался между 1-ой и 2-ой частями исследования, также показаны статистические различия между двумя группами и для различных показателей. Наиболее важным явилось то, что SAD снизился значительно быстрее за время первых 4-х недель исследования, указывая на преимущественное уменьшение висцерального жира. Напротив, WHR снизился за время 2-ой половины изучения, больше за счет снижения абдоминального жирового депо.

ОБСУЖДЕНИЕ: Независимо от механизма действиям CLA, ускорение действия в снижении веса происходит только в комбинации с диетой и физической активностью. Это также соответствует преимущественно естественному снижению более метаболически активного висцерального жира до перехода к снижению подкожного жира. Является ли данная пищевая добавка эффективной или нет, требует дальнейшего изучения.

КЛЮЧЕВЫЕ СЛОВА: избыточная масса тела, ожирение, конъюгированная линолевая кислота, индекс массы тела, соотношение окружности талии к окружности бедер, сагиттальный абдоминальный диаметр, процент содержания жира в организме, висцеральный жир, подкожный жир.

CONJUGATED LINOLEIC ACID ACCELERATES WEIGHT LOSS AND IMPROVES ANTHROPOMETRIC MEASURES IN OVERWEIGHT YOUNG ADULT MALES DURING WEIGHT LOSS PROGRAM

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BACKGROUND: With the increasing prevalence of obesity in Iraq, an increasing trend towards better physical fitness has emerged among young adults. At the same time, an increasing number of dietary supplements is offered to improve fitness and shed the extra weight. Conjugated linoleic acid (CLA) is commonly used for such purpose.

AIM: The current study was designed to test if CLA can actually accelerate weight loss when combined with dieting and moderate exercise and to examine its effect on anthropometric measures of obesity.

Received: 08.07.2017. Accepted: 19.11.2017.

SUBJECTS & METHODS: Sixty young males enrolled willingly in the study and were put on a low-carbohydrate low-fat diet and moderate high intensity interval exercise (HIIT) program. Forty of them were given CLA (1000 mg/day) for 8 weeks while the remaining twenty served as control group. Body mass index (BMI), waist/hip ratio (WHR), sagittal abdominal diameter (SAD) and body adiposity index (BAI) were recorded as baseline and again after 4 and 8 weeks.

RESULTS: The CLA-treated group showed significantly greater reduction in all four measures by the end of the study. The control group had significant but less decrease in BMI & SAD but not in WHR or BAI. The percent change difference between the first and second four weeks of the study also showed statistical difference among the two groups and for different measures. The most significant finding was that SAD dropped more rapidly during the first 4 weeks of the study indicating a preferential loss of visceral fat. Oppositely, WHR dropped during the second half of the study indicating loss of more abdominal fat stores.

DISCUSSION: Regardless of the mode of action of CLA, its accelerative effect in weight loss is augmented by the combination with dieting and physical activity. It also corresponds to the natural body preference to losing the more metabolically active visceral fat prior to switching to the loss of subcutaneous fat. Whether or not this effect is sustainable requires further study.

KEYWORDS: Overweight, obesity, conjugated linoleic acid, body mass index, waist/hip ratio, sagittal abdominal diameter, body adiposity index, visceral fat, subcutaneous fat

INTRODUCTION

The 2014 adult prevalence rate of obesity (body mass index (BMI) ≥ 30) in Iraq was 21.2% and the figures of overweight adults (BMI ≥ 25) was estimated to be higher than 50% [1]. However, during the past few years, there has been an increasing turnout among teenage and young Iraqi males towards better physical fitness, which entailed a surge in the number of gyms and clubs dedicated to such purpose. Many of these gyms also provide a variety of dietary supplements that allegedly boost metabolism, accelerate weight loss and improve muscle mass building. One of the commonly used of such supplements is conjugated linoleic acid (CLA). CLA covers a group of positional and geometric (cis or trans) isomers of the fatty acid called linoleic acid with a conjugated double bond [2]. Several mechanisms of action of CLA have been proposed by different studies including suppression of energy intake, lipogenesis and adipogenesis as well as enhancement of energy expenditure and preadipocyte apoptosis [3].While many studies showed favorable body compositional effects of CLA in different animal species, other studies suggested only a modest beneficial effects in humans [4]. Different dosing systems, isomer types and animal models compared to the few available human studies may be responsible for the discrepancies seen in CLA studies [5].

AIM

The current study was designed to determine the effect of CLA supplementation on anthropometric measures in young overweight Iraqi males undergoing a weight loss program of diet and moderate physical exercise.

SUBJECTS & METHODS

Settings

The study was carried out at two Gyms at Al-Karkh District (Baghdad, Iraq) over the period of 8 weeks (September 2016- October 2016).

Ethical issues

All participants were over 21 years old and were thoroughly informed of the study design and its purpose and signed an informed-consent form. Body measurements were recorded professionally in respected privacy. Subjects' confidentiality was not compromised at any time.

Definition of cases enrolled in the study, inclusion and exclusion criteria: The study included 60 male adults who were overweight (BMI= 25-29.9) and who enrolled in the aforementioned gyms for the purpose of losing weight. None of the subjects was on any drug that interfered with metabolism and had no endocrine or chronic illness that affects physical activity or body metabolism. All subjects agreed to the study program of dieting and physical exercise.

Sampling & Randomization

Sixty young males (24.7±1.78 years) were enrolled in the study. Subjects were selected randomly every other day over a period of two weeks, after their consent and willingness to participate.

Primary and secondary outcomes

The primary outcome was to determine whether or not CLA with moderate exercise & dieting can accelerate weight loss in comparison to dieting & moderate physical exercise alone. The secondary outcome was to study the changes in visceral and subcutaneous body fat depots over time using different anthropometric measures of obesity.

Caloric calculations

Individual basal metabolic rate was calculated using Mifflin-St.Jeor equation [6]:

$BMR = (10 \times weight\ in\ kg) + (6.25 \times height\ in\ cm) - (5 \times age\ in\ years) + 5$

Since subjects were put on moderate physical exercise (moderate to high intensity cardio exercise, 3-5 days/week) the daily caloric requirement was multiplied by a factor of 1.55 (Daily caloric requirement= BMR x 1.55) [7]. This put the participant's caloric requirements

at 2838.1±98.06 SD (Kcal/day). The requirement was adjusted after 4 weeks to accommodate the change in body weight.

Diet

All subjects were put on a modified low carbohydrate-low fat diet individualized to give 500 Kcal less than the daily requirements [8]. The diet consisted of 30% carbohydrates, 25% fats (<7% saturated fats), 35% proteins, 10% fresh fruits & vegetables. Participants were given a list of foods to avoid (e.g. sweets, butter, cheese, fast food), foods to consume regularly (e.g. fresh greens, fruits, whole grains, lean meat) and were instructed to consume 5-6 small meals/day.

Exercise

Subjects were taught to perform high intensity interval training (HIIT) 3-5 days a week using a treadmill [8]. The HIIT lasted 25 minutes and consisted of 5 cycles. Each cycle (5 minutes) consisted of 3 minutes of brisk walking (5-6 km/hr) followed by 2 minutes of inclined jogging (9.5 km/hr). The routine was preceded by a 3-minute worm-up period and followed by a 3-minute cool-down period to prevent muscle spasms.

Study groups & anthropometric measurements

Test subjects were divided into two groups. The first group (N=40) were given a single daily dose of 1000 mg of CLA (Nutrex Research Inc., USA) for 8 weeks. The CLA isomer used was of the 10-trans, 12-cis variety. The second group (N=20) were kept only on diet & exercise for 8 weeks.

All anthropometric measurements and calculations were recorded just before the study began (initial record), at the end of week 4 and at the end of week 8. Measurements were taken after 4 hours from a meal and were performed according to the World Health Organization's data gathering protocol [9]. Calculations were done according to established epidemiological equations [10].

Weight was recorded with no shoes and wearing just shorts using an electronic body scale (ANYSCALES® TCS-200-RT, Australia) to the nearest 100g. The scale also contained a height rod that was used to measure the standing height (in the anatomical position) to the nearest centimeter. Waist & hip measurements were taken with the subject standing in the anatomical position wearing shorts only. Waist circumference was measured at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest, using a stretch-resistant flexible tape measure. Hip circumference was measured around the widest portion of the buttocks, with the tape parallel to the floor [11]. Each measurement was repeated twice; if the measurements were within 1 cm of one another, the average was calculated. If the difference between the two measurements exceeded 1 cm, the two measurements were repeated. The sagittal abdominal diameter (SAD) was taken with the subject in the supine position with bent knees using a sagittometer [9], a sliding beam caliper with a ruler (SkynDex®, USA, d: 0.1 cm). The measurement was taken at the level of the waist circumference with the lower arm of the caliper touching the subject's back and the upper arm just touching the abdomen at the end of relaxed expiration, and the shaft of the caliper in the vertical position. A normal value of SAD is <25 cm [12].

Body mass index (BMI) was calculated by dividing the weight in Kg by the squared value of the height in meters (Kg/m2). A value of 18.5-24.9 is normal while a value of 25-29.9 is considered overweight [13]. The waist/hip ratio was calculated by dividing the WC by the HC in centimeters. A value greater than 0.9 is considered high [14].

The body adiposity index (BAI) was calculated mathematically according to the formula:

BAI= Hip circumference (m)/ [Height(m) x √(Height (m))]-18 [15].

A desirable BAI value is 8%-21% [16].

Statistical analysis

Data were analyzed by means of SPSS software version 18.0. Variables and scores were normally distributed and presented as frequency percentage for categorical variables and mean ± standard deviation (SD) for numerical variables. Independent student t-test was used to compare groups' means. Chi square test was used to compare differences in categorical variables between the two groups.

RESULTS

None of the subjects supplemented with CLA complained of any side effects during the period of the study. Table 1 shows the frequency distribution of abnormal anthropometric measures of overweight in CLA-treated and control subjects at the beginning and at the end of the study. At the end of the study, there was a dramatic decrease in BMI & SAD in both groups but the decrease was greater in CLA group. The WHR & BAI decreased significantly in the CLA group but not in the control group.

Table 2 shows the changes over time in anthropometric measures of obesity in CLA-treated and control subjects. BMI & SAD decreased steadily in both groups but the total percent changes was significantly greater in the CLA group (Fig.1). The CLA group started with higher WHR values but dropped to similar levels to the control group by the end of the study indicating a faster rate of decrease. The change in BAI was significantly greater in the CLA group at both 4 and 8 weeks periods.

Figure 1 shows the percent change in anthropometric parameters of obesity over 4 and 8 weeks duration of the study. For all parameters and over both durations, the percent change in the CLA- treated group was statistically greater than in the control group. The only exception was the percent change in the SAD after the second 4 weeks where both groups seemed to change at a similar rate.

The amount of change in BMI & BAI in both groups was not significantly different between the first and second 4 weeks of the study. The WHR dropped at significantly greater levels during the second 4 weeks of the study in both groups. The decrease in SAD was significantly greater in the CLA-treated group during the first 4 weeks of the study. On the contrary, the SAD dropped

Table 1. Initial and final frequency distribution of abnormal anthropometric measures of obesity in CLA-treated and control subjects

Variable	Group			
	CLA (frequency %)		Control (frequency %)	
	Initial	Final	Initial	Final
Overweight BMI	100%	22.5%**	100%	35%**
High WHR	97.5%	37.5%**	95%	90%
High SAD	75%	5%**	65%	5%**
High BAI	90%	22.5%**	95%	85%

BMI: Body Mass Index, WHR: Waist/Hip Ratio, SAD: Sagittal Abdominal Diameter, BAI: Body Adiposity Index, **: High statistical significance with P-value<0.01

Table 2. Changes over time in anthropometric measures of obesity in CLA-treated and control subject. (Figures represent Mean±SD)

Variable	CLA			Control		
	Initial	At 4 weeks	At 8 weeks	Initial	At 4 weeks	At 8 weeks
BMI	27.46±1.08	26.04±1.13	24.45±1.01	26.97±0.76	25.91±0.80	24.94±0.84
WHR	0.969±0.08*	0.958±0.07	0.927±0.08	0.941±0.002	0.938±0.002	0.927±0.002
SAD	27.32±3.47	23.28±2.29	20.69±4.88	26.32±3.17	24.31±4.11	21.66±9.43
BAI	24.48±2.27	21.83±2.8**	20.21±3.09**	24.85±2.14	23.54±2.01	22.64±4.32

BMI: Body Mass Index, WHR: Waist/Hip Ratio, SAD: Sagittal Abdominal Diameter, BAI: Body Adiposity Index, *: statistical significance with P-value<0.05, **: High statistical significance with P-value<0.01

at significantly greater levels in the control group during the second 4 weeks.

DISCUSSION

The current study was designed according to the standard rule for losing weight, which is to create an energy deficient state by reducing energy intake and increasing energy expenditure [17]. The reduction in anthropometric parameters of obesity was significantly greater in subjects supplemented with CLA indicating a beneficial role of the drug in weight reduction. Other human studies are in agreement in that taking CLA supplements [18] or food products rich with CLA (e.g. dairy products) [19] is beneficial in weight reduction in the presence of caloric restriction. The exact mechanism by which CLA works is still controversial among different studies. Some studies proposed that CLA reduces food intake & fat deposition with or without increasing energy expenditure [3]. Other researchers claimed evidence of CLA reducing preadipocyte maturation and increasing mature adipocyte apoptosis [20]. This latter explanation is more applicable in the current study because of the pre-calculated caloric restriction and control of dietary intake.

The change in anthropometric measures of obesity in the CLA- treated subjects of this study was significantly greater than the control group except for the body mass index, which changed at similar levels in both groups. One of the major limitations of BMI is its inability to differentiate between lean body mass and body fat depots [21]. Age, sex, ethnicity and muscularity are other affective factors [22].

In the current study, the SAD, WHR and BAI did not decrease significantly in the control group, but the BMI

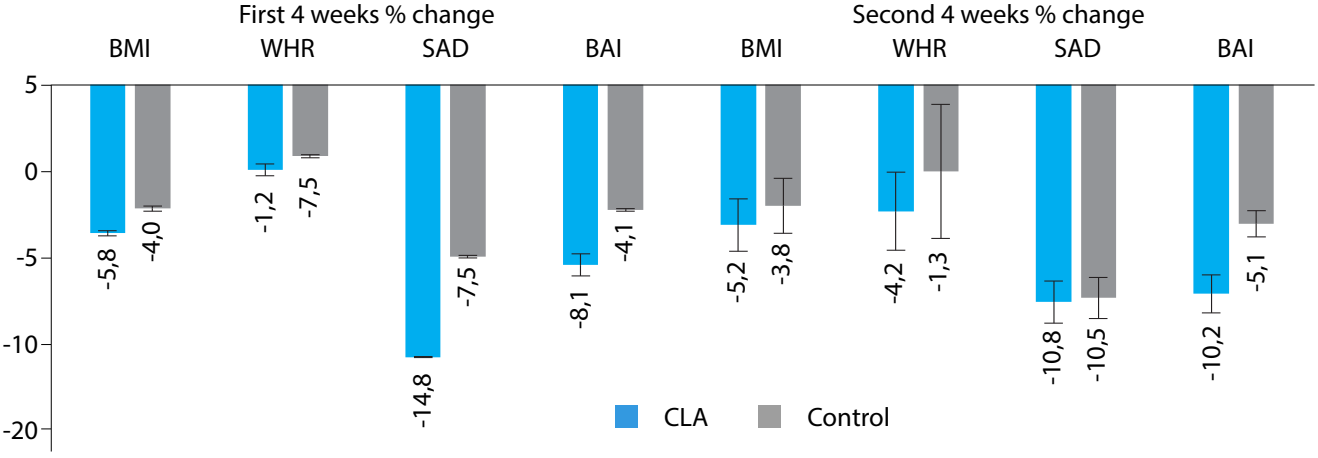

Figure 1. Percent change in anthropometric measures of obesity in CLA-treated & control subjects after 4 & 8 weeks duration.
Data represe=Mean, Error bars=SD. BMI: Body Mass Index, WHR: Waist/Hip Ratio, SAD: Sagittal Abdominal Diameter, BAI: Body Adiposity Index, *: statistical significance with P-value<0.05

did. Moreover, the reduction in BMI during the second 4 weeks of the study seemed to slightly slow down in both groups, possibly due to a build up of muscle mass secondary to the moderate HIIT exercise. It becomes apparent that body fat distribution is a more important determinant factor of obesity-related metabolic abnormalities than the degree of excess weight as measured by BMI.

The supine SAD is a measure of visceral abdominal tissue (VAT) based on the fact that subcutaneous tissue is displaced from the measuring caliper by the effect of gravity [23]. On the other hand, erect WHR takes into account the waist circumference that is affected by both VAT and SAT [24]. Previous weight loss studies proved that there is preferential loss of VAT to SAT with moderate dietary restriction [25].

In the current study, reduction of SAD preceded reduction in WHR. The reduction in VAT as indicated by the reduction in SAD occurred more quickly and at higher levels in CLA treated subjects during the first 4 weeks of the study but in the control group, it gradually increased towards the second 2 weeks of the study. This indicates an accelerative effect of CLA in reduction of VAT. This acceleration may be related to the fact that VAT is more metabolically active than SAT possibly due to more cellularity, greater vascularization, more innervation and greater susceptibility to certain hormones like glucocorticoids (which are in turn stimulated by dieting and exercise) [26]. The SAD continued to decrease significantly in the control group during the second 4 weeks possibly because the fat loss was still preferentially directed towards the VAT. This is supported by the reduction in WHR, which in both groups occurred modestly during the first 4 weeks of the study but accelerated over the second 4 weeks, but to greater extent in the CLA-treated subjects. Here, the effect of CLA on WHR and SAT loss may be related to exercise. HIIT exercise can significantly reduce VAT in overweight adults even without dieting [27] but takes longer time/harder work to affect abdominal SAT since SAT shows adaptive responses to exercise training [28]. CLA may alter such adaptive responses after exhaustion of preferential loss of VAT. Possible mechanisms include increased exercise and postexercise fat oxidation and enhanced catecholamine-induced lipolysis [29].

CONCLUSION

While dietary restriction and increased physical activity provide satisfactory results in reducing body mass and correcting anthropometric measures of obesity in overweight males, CLA supplementation can accelerate such results. Whether such effect is similar at higher levels of obesity and whether or not it is maintained over time requires further investigation.

ACKNOWLEDGEMENT

The author declares no conflict of interest or special funding for the current work. The author would also like to acknowledge the appreciable help & co-operation of Mr. Rami M. Khalid.

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Аккила С.С.. Конъюгированная линолевая кислота и её влияние на увеличение скорости снижения веса и улучшение антропометрических показателей у молодых мужчин с избыточной массой тела на протяжении комплексной программы по снижению веса. // Ожирение и метаболизм. — 2018. — Т.15. — №. 1 — С.19-24. doi: 10.14341/OMET2018119-24

TO CITE THIS ARTICLE:

Akkila SS. Conjugated linoleic acid accelerates weight loss and improves anthropometric measures in overweight young adult males during weight loss program. *Obesity and metabolism*. 2018;15(1):19-24. doi: 10.14341/OMET2018119-24